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Erratum: Time dependence in $B \to V\ell\ell$ decays

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Abstract: This erratum corrects typos and provides comments on statements in the article "Time dependence in $B \to V\ell\ell$ decays". All results, figures and conclusions in the original published version are correct and remain unchanged.

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1. The paper contains a number of misprints related to notation, which can easily be identified from the context:

- In eqs. (2.7), (2.10), (2.11), (2.17) and (2.18): the angle θ_K should be denoted θ_M to have the notation consistent with appendix A.
- In the last paragraph of section 2.2: instead of "$j = 1s, 1s, 2s, 2c, 3$" and "$j = 4, 5, 6s, 6c, 7, 8, 9$", should read "$i = 1s, 1c, 2s, 2c, 3$" and "$i = 4, 5, 6s, 6c, 7, 8, 9$", respectively.
- In the fourth bullet point in section 2.3: "$i = 1, 2s, 2c, 3, 4, 5, 6s, 6c$" should be "$i = 1s, 1c, 2s, 2c, 3, 4, 5, 6s, 6c$". In addition, "$J_i + \bar{J}_i$" should read "$J_i - \widetilde{J}_i$".
- In eq. (3.13), "j" should be "i" in both lines.
- In eqs. (3.15)-(3.18), the coefficients $I_{2c}, \widetilde{I}_{2c}$ etc. should be $J_{2c}, \widetilde{J}_{2c}$ etc., according to the notation throughout the paper.
- In appendix A:
  - Below eq. (A.1), "$\bar{B} \to \bar{M} \cdots$" should read "$\bar{B} \to \bar{V} \cdots$".
  - The mass of the particle V is denoted m_M, while it would be more convenient to denote it m_V everywhere.
  - Before eq. (A.4), "rest-frame of M" should read "rest-frame of V".

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2. The three modes of interest considered in this paper as illustration, are all $b \to s$ transitions. Neglecting CKM-suppressed contributions and in the absence of New Physics, the (time-independent) amplitudes carry a global weak phase given by $\arg(-V_{ts}) = \beta_s$:

$$A \sim e^{i\beta_s}\,, \quad A^*, \bar{A}, \widetilde{A} \sim e^{-i\beta_s}\,. \tag{1}$$

In the SM, this phase is very small and can be neglected, leading to eqs. (3.19), (3.20) for Q_8^- and Q_9, which are proportional to $\cos\phi$ as stated in the published version of the paper.

If one wants to be more precise and keep β_s, one should trade "$\cos\phi$" for "$\cos(\phi_q - 2\beta_s)$" (where ϕ_q stands for the mixing angle in the B_q system) in the following places:

- In eqs. (3.19), (3.20) and in the paragraph below.
- In the last bullet point in the introduction. Here, we should remark that this statement applies to $b \to s$ transitions.
- In the paragraph before eq. (4.12).
- In the paragraph after the bullet points in section 4.2.

We note that in the SM, $(\phi_q - 2\beta_s) \simeq -2\beta$ for B_d and $(\phi_q - 2\beta_s) = 0$ for B_s.

3. In section 2.4 the symmetries of the time-dependent distribution are discussed to determine which s_i may carry additional information not accessible through time-independent analyses. From the explicit expressions given in appendix C, we see that (neglecting lepton mass terms and weak phases in the amplitudes):

$$\begin{aligned}
s_{1s,2s} &\sim \sin\phi \cdot \mathrm{Re}\big[A_\parallel^L A_\parallel^{L*} + A_\parallel^R A_\parallel^{R*}\big] - (\parallel \to \perp)\,, && (2)\\
s_{1c,2c} &\sim \sin\phi \cdot \mathrm{Re}\big[A_0^L A_0^{L*} + A_0^R A_0^{R*}\big]\,, && (3)\\
s_3 &\sim \sin\phi \cdot \mathrm{Re}\big[A_\parallel^L A_\parallel^{L*} + A_\parallel^R A_\parallel^{R*}\big] + (\parallel \to \perp)\,, && (4)\\
s_4 &\sim \sin\phi \cdot \mathrm{Re}\big[A_0^L A_\parallel^{L*} + A_0^R A_\parallel^{R*}\big]\,, && (5)\\
s_5 &\sim \cos\phi \cdot \mathrm{Im}\big[A_0^L A_\perp^{L*} - A_0^R A_\perp^{R*}\big]\,, && (6)\\
s_{6s} &\sim \cos\phi \cdot \mathrm{Im}\big[A_\parallel^L A_\perp^{L*} - A_\parallel^R A_\perp^{R*}\big]\,, && (7)\\
s_7 &\sim \sin\phi \cdot \mathrm{Im}\big[A_0^L A_\parallel^{L*} - A_0^R A_\parallel^{R*}\big]\,, && (8)\\
s_8 &\sim \cos\phi \cdot \mathrm{Re}\big[A_0^L A_\perp^{L*} + A_0^R A_\perp^{R*}\big]\,, && (9)\\
s_9 &\sim \cos\phi \cdot \mathrm{Re}\big[A_\parallel^L A_\perp^{L*} + A_\parallel^R A_\perp^{R*}\big]\,. && (10)
\end{aligned}$$

Therefore the only coefficients s_i that (in this approximation) do not remain invariant are s_5, s_{6s}, s_8 and s_9, which contain additional information not accessible from the usual angular distributions of flavour-specific decays such as $B_d \to K^*(\to K^+\pi^-)\ell\ell$. In conjunction with the studies performed in earlier sections, this leads to focus on s_8 and s_9.

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